design, a bi-layer material layer, and surface doping to introduce a bandgap into the graphene base material layer.

38. The transistor device according to claim **28**, further comprising a collector transition layer disposed at the collector interface with the graphene material base layer (collector/base interface and forming an interface with each of the graphene material base layer and the collector, wherein the collector transition layer is configured to smooth a bandgap between the graphene material base layer and the collector and to facilitate the collection of electrons into the collector.

39. The transistor device according to claim **28**, wherein the emitter comprises a semimetal material.

40. The transistor device according to claim **28**, further comprising an emitter transition layer within the emitter disposed at the emitter interface with the graphene material base layer (emitter/base interface) and forming an interface with each of the emitter and the graphene material base layer;

wherein the emitter transition layer is configured to provide one of a thermionic emission injection structure, a planar doped barrier thermionic emission injection structure, a camel thermionic emission injection structure, a graded bandgap thermionic emission structure, a N-type/i-layer/P-type/i-layer (NIPI) doping superlattice injection structure, a superlattice injection structure, a tunneling injection structure, a metal-oxide tunnel injection structure, a Fowler Nordheim injection structure, a resonant tunneling injection structure, between the emitter and the graphene material base layer.

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